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PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Improvements in or relating to Fuel Injectors for Internal Combustion Engines

We, R. A. LISTER & COMPANY LIMITED, a British Company, of Dursley, Gloucestershire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention comprises improvements in or relating to fuel injectors for internal combustion engines, especially those for small diesel engines.

In practice, it has been found particularly in small engines that the quantity of fuel flowing through the spray orifices of the injector nozzle is often insufficient to prevent overheating of the surrounding metal, with the result that deposits, particularly of carbon tend to form and block in the orifices.

According to this invention a fuel injector for an internal combustion engine comprises a fuel chamber, the end wall of which is integral with its side wall and a single permanently unobstructed spray orifice communicating with said chamber, the thickness of the chamber wall part through which the orifice extends being substantially greater than the length of the flow path through said orifice so as to give a good spray atomisation of fuel and the outer end of the orifice opening into a circular recess recess in the outer face of said wall part and the ratio of the length of the spray orifice to its diameter lying between .5 to 1.5 and the ratio of the maximum diameter of the recess to the diameter of the orifice lying between 2 and 6.

Preferably the above mentioned ratio is 4.

To obtain a good spray atomisation over the range of fuel flows experienced in operation, the diameter of the spray orifice is limited and this in turn limits the length of the flow passage through the orifice if the orifice restriction is not to be too great.

Preferably said length of the spray orifice is equal to the diameter of the orifice.

By employing the arrangement of the invention, however, such small orifice dimensions may be retained whilst employing a thick nozzle wall which ensures a lower nozzle temperature and reduces the tendency for blockage of the spray orifices by deposits.

The ratio of the thickness of the wall in which the orifice and recess are formed to the diameter of the orifice may be between 2 and 6. Preferably the ratio is 4.

In one particular form the recess is cylindrical and of greater diameter than the spray orifice and the orifice opens centrally into it at one end. The length of the recess is determined in relation to the diameter so that the spray is substantially unaffected. Preferably its diameter is greater than its length.

In another form, the recess is conical and its wall diverges from the spray orifice at an angle so that the spray is substantially unaffected. For example, the angle may be between 60° and 120° and is preferably 90°.

Two examples of nozzle embodying this invention are shown in axial section in each of Figures 1 and 2.

The liquid fuel in each case is delivered at pressure to a chamber 10 within the nozzle 12 and it is delivered from this chamber through a spray orifice into the engine cylinder space.

The size of the orifices 11, both as regards diameter (d) and length (l), is determined by the fuel pressure in chamber 10 and the range of fuel flows to be catered for and are such as to obtain good spray atomisation particularly at low fuel flows.

It will be clear that, if as has always been the practice, the wall thickness of the nozzle

is made equal to the desired length (l) of the spray orifice, the wall will be thin, since the dimension (l) is always small.

It will be seen, however, that the wall thickness (L) of the nozzles of this invention has been made substantially greater than the dimension (l) so as to obtain better heat conduction away from the nozzle and a consequent low temperature of it, and to avoid increasing the length of the orifice, correspondingly the orifice is arranged to open on its delivery side into a larger recess which does not interfere with the spray.

In Figure 1, the recess 13 is cylindrical and has a diameter (D), substantially greater than the orifice diameter (d). The greater the ratio $\frac{D}{d}$, the greater may be the ratio $\frac{L}{d}$.

In Figure 2, the recess 14 is conical and the orifice 11 opens into it at the apex. The cone angle (α) is selected so that the spray is not interfered with.

The following table gives preferred ratios of the dimensions of the orifice and recess and also ranges over which these may vary. The value of D in the case of Figure 2 refers to the maximum diameter of the recess 14.

Ratio	Preferred Value	Variations in Value
$\frac{D}{d}$	4	2 to 6
$\frac{L}{d}$	4	2 to 6
$\frac{l}{d}$	1	.5 to 1.5
α	90°	60° to 120°
$\frac{L}{l}$	3	1.33 to 12

WHAT WE CLAIM IS:—

1. A fuel injector for an internal combustion engine comprising a fuel chamber, the end wall of which is integral with its side wall and a single permanently unobstructed spray orifice communicating with said chamber, the thickness of the chamber wall part through which the orifice extends being substantially greater than the length of the flow path through said orifice so as to give a good spray atomisation of fuel and the outer end of the orifice opening into a circular recess in the outer face of said wall part and the ratio of the length of the spray orifice to its diameter lying between .5 to 1.5 and the ratio of the maximum diameter of the recess to the diameter of the orifice lying between 2 and 6.

2. A fuel injection according to claim 1 wherein the ratio of the diameter of the recess to the diameter of the orifice is 4.

3. A fuel injector according to either of the preceding claims wherein the length of the spray orifice is equal to its diameter.

4. A fuel injector according to any of the preceding claims wherein the ratio of the thickness of the wall of the nozzle in which said orifice and recess are formed to the diameter of the orifice lies between 2 and 6.

5. A fuel injector according to claim 4 wherein said ratio is 4.

6. A fuel injector according to any of the preceding claims wherein the recess is cylindrical and of greater diameter than the spray orifice and the orifice opens centrally into it at one end.

7. A fuel injector according to claim 6 wherein the diameter of the recess is greater than its length.

8. A fuel injector according to any of claims 1 to 5 wherein the recess is conical and its wall diverges from the spray orifice at an angle so that the spray is substantially unaffected.

9. A fuel injector according to claim 8 wherein said angle lies between 60° and 120°.

10. A fuel injector according to claim 9 wherein said angle is 90°.

11. A fuel injector according to any of the preceding claims wherein the ratio of the thickness of the wall in which the orifice and recess are formed to the length of said flow path through the orifice is between 1.33 to 12 and is preferably about 3.

12. A fuel injector for an internal combustion engine substantially as described with reference to Figure 1 or Figure 2 of the accompanying drawing.

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1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 1.

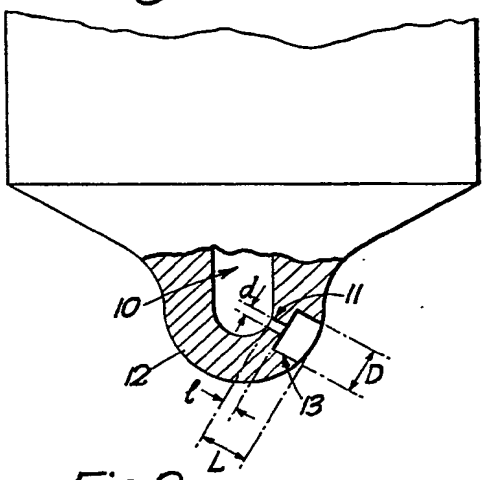

Fig. 2.